DOCUMENT RESUME

ED 150 548 CS 003 912

AUTHOR Goetz, Ernest T.
TITLE Inferences in the Comprehension of and Memory for Text. Technical Report No. 49.
INSTITUTION Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Jul 77
CONTRACT 400-76-0116
GRANT NIE-G-74-0007
NOTE 97p.

EDRS PRICE MF-$0.83 HC-$4.67 Plus Postage.
DESCRIPTORS *Cognitive Processes; Memory; Prose; *Reading Comprehension; *Reading Processes; *Reading Research; Recall (Psychological); Secondary Education
IDENTIFIERS *Center for the Study of Learning (Illinois); *Inference

ABSTRACT

Two studies investigated whether variations in the importance of inferences and the salience of premises within a text would affect the probability that the inference would be made. Six stories of about 500 words were used, with eight variations of each story. The target inference, and its plausibility, was constant across all versions. Inference was tested using multiple-choice questions in the first experiment and cued recall in the second experiment. Results of both studies indicated that people are more likely to make an important inference than an unimportant inference. The first study also revealed that people are more likely to rate an important inference as having been stated in the passage. In both studies, highly salient premises were also found to increase the probability that an inference would be made. (Author/AA)

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CENTER FOR THE STUDY OF READING

Technical Report No. 49

INFERENCES IN THE COMPREHENSION OF AND MEMORY FOR TEXT

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July 1977

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A version of this paper was submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Psychology in the Graduate College of the University of Illinois at Urbana-Champaign, 1977.

I would like to thank the many people who helped me complete this project: my advisor Richard C. Anderson; committee members William Brewer, Ann Brown, and Rand Spiro; my firends and colleagues Diane Schallert, Ralph Reynolds, Jim Pichert, Sally Standiford, Dean Radin, Zohara Shifrin, and Katy Donner; and the superior clerical and support staff of the Center for the Study of Reading, and in particular Mike Nivens, Larry Shirey, and Bonnie Anderson. The cooperation of the teachers and students at Georgetown High School, Georgetown, Illinois; Milford Township High School, Milford, Illinois; and Columbian High School, Tiffin, Ohio is gratefully acknowledged.

This research was supported in part by the National Institute of Education under Contract NO. US-NIE-C-400-76-0116 and Grant No. HEW-NIE-9-74-0007.

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CHAPTER 1

INTRODUCTION

Overview

Two claims are assumed to be beyond dispute:

1. Inferences are an integral part of discourse comprehension and memory.
2. In comprehending discourse, people do not make all possible inferences.

Strong intuitive arguments can be mustered for the truth of both statements.

That the first is true can be seen by an examination of the communicative process. Grice (1975) and Gordon and Lakoff (1975) have made a detailed analysis of human communication in terms of the tacit rules, or "conversational postulates," which govern the behavior of both the sender (writer or speaker) and receiver (reader or listener) of communications (written or oral discourse). The general goal of the sender is to be understood by the receiver. Thus a speaker will not use an utterance unless he is convinced that the listener will have the requisite knowledge of the language, knowledge of the culture, and knowledge of the world. A further assumption made by the sender is that the receiver will use this knowledge not only to comprehend the literal meaning of the discourse, but also to derive inferences that complete the discourse where the message itself was incomplete or unspecified. Thus, if a speaker says,

I saw John driving down the road.

he must believe that the listener knows English and knows what a road is. He further assumes that the listener will draw the inference that John was

driving a car. Inference makes it possible for the sender to convey a great deal of information in a message of manageable size. If the sender had to state explicitly all the information which he or she wished to convey, the sheer bulk of the resulting discourse would make the communication of even the simplest ideas difficult.

Similarly, the major goal of the receiver is to understand the message. The receiver makes the assumption that the message is potentially sensible, even though incompletely specified, and uses inference and other constructive processes to render it so. Inference also makes it possible for the receiver to go beyond the information which the sender intended to communicate.

While the receiver must make some inferences in order to comprehend the discourse, he or she cannot be expected to make all possible inferences. This must be so simply because the number of possible inferences is essentially infinite. Thus, in the above example, one possible string of inferences might run:

John was driving a car.

The car was powered by gas.

John had purchased gas for the car at a filling station.

The filling station had an attendant.

The attendant was paid a wage.

Clearly this string of inferences could be carried out to any length. Inference strings could branch at any point and in many directions. Thus, other inference strings might be constructed which run from the cost of gasoline, to petroleum company profits, to U. S. foreign policy, or from road construction, to labor unions, or road grading equipment.

Since people make some but not all possible inferences, the specification and understanding of the processes which determine which inferences are, in fact, made becomes a major problem in the understanding of discourse comprehension and memory. In addressing this problem, the two studies reported in this paper represent attempts at influencing the probability that an inference would occur by systematically varying text. The major prediction was that a subject would be more likely to make an inference if that inference were important than if it were unimportant.

Inferences in Discourse: A Brief Review

The study of inferential processes in discourse comprehension and memory, and indeed, of discourse comprehension and memory itself, is almost a new field for experimental psychology. To recapitualte a well-known history, Ebbinghaus (1883) invented the nonsense syllable in the hope that the novelty and simplicity of artificially constructed letter strings would minimize contact with preexisting knowledge, thus enabling the uncontaminated study of the formation of associations, or the accretion of trace strength. The long-standing hope of associative psychologists and behaviorists is that there exist general laws of learning and memory, which, though best studied with simple organisms (rats, pigeons) in simple environments (t-mazes, Skinner boxes), would generalize to and prove sufficient to explain the behavior of the seemingly most complex human being reading the most complex novel. Thus were nonsense syllables studied, and thus, for the most part was text ignored, despite muffled warnings that things might not be so simple. The recent work of Montague, Adams, Prytullac, and others (see Montague, 1972, for a review) indicated that a result of presenting college sophomores with nonsense syllables, paired

associates, and word lists is often to goad them into devising highly complex and idiosyncratic strategies in order to impose order and meaning on the senseless scrambles foisted on them by the experimenter. This work stands as a striking confirmation and long overdue acknowledgement of Bartlett's (1932) warning that apparently simple experimental materials are no guarantee that ensuing psychological processes will be simple when the organism under study is as rich in complexity as a human being.

Given this background, it is perhaps not surprising that inferential processes, although documented near the advent of scientific psychology, have been largely ignored almost to the present. Binet and Henri (1894; Thieman & Brewer, in press) noted what they called "errors through imagination" in the recall of stories. These errors were said to be characterized not so much by change in meaning as by addition to the meaning of the original version. Thus, upon hearing "Thursday" a child would recall "last Thursday" or "Thursday evening." Likewise, "one of them" became "the youngest one," and "his parents' home" was recalled as "his home."

Bartlett's (1932) account of reconstructive processes in the repeated reproduction (recall) of "The War of the Ghosts" is the most famous early account of inferential elaboration of discourse recall. Bartlett reported that some subjects used the general setting and affective aspects, along with embellished details or incidents of the story, to reconstruct an elaborate, if inaccurate, story. Some subjects "rationalized" the story, rendering it more sensible by filling gaps or distorting events, as, for example, by postulating causal relations between events.

Although the work of Binet and Henri and of Bartlett might have served as a springboard for the study of inferential processes, it was, for the

most part, ignored or disputed. Gomulicki (1956) investigated the immediate recall of prose passages of 15 to 200 words in length, and found that omissions were very frequent, while inferential elaboration was quite rare. He concluded that memory for prose was more accurately described as abstractive than constructive, a view shared by Kay (1955) and echoed by Zangwill (1972). In fact, Gomulicki reported that when judges were given both recalls and actual abstracts of the same passages, they did little better than chance at distinguishing them. It should, however, be pointed out that this failure does not ensure that no psychologically useful distinctions can be drawn between the processes involved in abstracting a text and in recalling it: if judges were (as they often are on television) unable to distinguish margarine from butter, it would, nevertheless, be unreasonable to conclude that they were produced by the same processes.

Gauld and Stephenson (1967) suspected that the changes and distortions in recall which Bartlett found were due to deliberate inventions by subjects who want to "fill up gaps in their memory," a process which should be distinguished from memory itself. They ran several studies using the "War of the Ghosts" which showed that telling subjects to recall only what was in the story and to leave gaps rather than invent if they had forgotten sharply reduced the number of meaning-changing intrusions or additions. If the subjects were simply told to be accurate, the effect was the same as the longer injunction. Of course, these results are amenable to other interpretations. The former instruction might set up demand characteristics (Orne, 1962) which favor the production of gaps. The latter, as well as the former, might cause the subject to raise his or her subjective criterion for the acceptable confidence level for response emission (Cofer, 1961, 1967;

Adams & Bray, 1970), causing the subject to suppress information he or she remembers.

Although the importance of inference in discourse was long disputed, a recent surge of evidence and interest has thrust its study into the spotlight it deserves. The work of Bransford and his colleagues has been instrumental in this turnabout. Bransford, Barclay, and Franks (1972) reported that subjects who read sentences like,

Three turtles rested on a log and a fish swam beneath them.

had higher recognition scores for foils like,

Three turtles rested on a log, and a fish swam beneath it.

than did subjects who read sentences in which the spatial relationships were changed ("beside" substituted for "on" in both the target sentence and foil). These recognition confusions were due to inferences which resulted from the interaction of the subjects' knowledge of spatial relationships with the information supplied by the study sentence.

In another study, Johnson, Bransford, and Solomon (1973) presented subjects with brief passages such as:

John was trying to fix the bird house. He was pounding the nail when his father came out to watch him and to help him do the work.

or,

It was late at night when the phone rang and a voice gave a frantic cry. The spy threw the secret document into the flames just in time, since 30 seconds longer would have been too late.

They found that subjects who heard such passages were very likely to falsely recognize statements which included an unstated instrument (e.g., John was using the hammer to fix the birdhouse) or consequence (The spy burned the

document just in time). Subject who heard control passages where minimal changes in the wording altered the meaning (e.g., looking for the nail instead of pounding the nail; pulled the secret document from the fire instead of threw the secret document into the fire) easily rejected the foils.

Brewer (1974) has produced dramatic demonstrations of inferences. He showed that subjects tended to recall inferences which were probable, though not logically necessary, consequences of the sentences presented. Thus, the sentences,

The hungry python caught the mouse.

The safe cracker put the match to the fuse.

The bullet hit Superman's chest.

were often recalled as,

The hungry python ate the mouse.

The safe cracker lit the fuse.

The bullet bounced off Superman's chest.

Such inferences constituted 20% to 30% of the total recalls across 46 items and ran as high as 80% to 88% of the recalls of some sentences.

Another line of research which has provided a striking demonstration of inferential processes is the research on linear orderings of Potts (e.g., 1972), Barclay (1973), and others. This research has shown that when subjects are shown a series of sentences Bill is stronger than Tom and Tom is stronger than John, they falsely recognize sentences like Bill is stronger than John which were never presented but could be inferred.

Toward a Definition of Inference: How Broad a Term?

The trickle of studies on inference has become a deluge, but before examining more closely current research on inferences in discourse, a critique of current use of the term must be presented, and the meaning of the term as used in this paper needs to be clarified.

The first notion of inference, which in the present context must be rejected, is inference as defined in formal logic. While logical inferences are important, the cases sanctioned by logic or mathematics do not exhaust the types of inference involved in natural language comprehension. Formal systems involve an idealized, tidy notion of inference which is unsuited for use as a psychological model. The inferential processes of humans are simply not limited to, nor are they always guided by, those forms of inference permitted in logic and mathematics.

A second possible notion of inference, which must also be rejected, is that anything that is recalled or recognized as having occurred in a text, but which was not a part of the text, constitutes an inference. This definition of inference is too broad. Material which is recalled or recognized, perhaps on the basis of thematic or topical relationship to the text, but which does not specifically depend on any of the information in the text, should be distinguished from inference. Several recent studies have shown that subjects sometimes inject information from their prior knowledge when the topic of the text is familiar. For example, Kintsch and Van Dijk (in press) report an experiment in which subjects read paragraphs on familiar topics such as Bible stories. One story dealt with Joseph and his brothers in Egypt. When subjects were tested for free recall after

48 hours, subjects seemed completely unable to distinguish between the story and their prior knowledge, and tended to produce everything they knew about Joseph and his brothers, no matter how unrelated to the text. Sulin and Dooling (1974) presented subjects with brief biographical passages which were purportedly about fictitious or famous persons. When tested one week later, subjects who read the famous person versions tended to falsely recognize statements of common knowledge about the main character which were not specifically related to the text. Brown, Smiley, Day, Townsend, and Lawton (1977) have reported similar results with grade school children.

In order to qualify for classification as an inference, the material must at least depend upon specific information in the text. Being able to relate recalled or recognized material to specific information in the text, however, is not a sufficient criterion for classification as a text-based inference. Frederiksen (1976) has developed a taxonomy of text-based inferences in which every proposition in a free recall protocol is identified with the proposition in the text with which it is most closely related. The inferential process necessary to generate the inference from the text base is classified according to the taxonomy which consists of eight major inference types which are divided into 26 classes, which are further divided into subclasses. The difficulty with Frederiksen's system is that, as currently constituted, anything which is recalled will be matched with some proposition in the text base and then classified as some type of inference. For example, if a subject reads,

The dog chased the cat.

and then recalls,

An animal did somehting.

this would be classified as a superordinate inference. When a subject recalls,

She (Mother) won't get mad.

after having heard,

Mother will get mad.

the recall is classified as a negation inference. When used so broadly, the term "inference" becomes vacuous.

Clearly what is needed is a definition of inference which avoids the problems of excessive narrowness on the one hand and indiscriminate inclusion on the other hand. Brewer (1974), one of the first to seriously come to grips with this problem, noted that any notion of logical inference would be too narrow to serve as a definition of psychological inference. He set out to specify an area of psychological inference which falls outside the bounds of formal logic. Such inferences, called "pragmatic inferences" since they derive from expectations based on a person's knowledge of the world, are identified by the but not test. One sentence is said to pragmatically imply another if negating the second sentence and conjoining it to the first with but results in an acceptable sentence. Thus,

The hungry python caught the mouse.

is said to pragmatically imply,

The hungry python ate the mouse.

because,

The hungry python caught the mouse, but did not eat it.

is an acceptable sentence. Likewise,

The safecracker put the match to the fuse.

pragmatically implies,

The safecracker lit the fuse.

as evidenced by the acceptability of,

The safecracker put the match to the fuse, but it did not light.

Brewer demonstrated that the but not test, which was based on Lakoff's (1971) analysis of the use of but as a denial of expectation, produces unacceptable sentences when applied to sentences which are linked by logical implication and also sentences which lack an inferential relationship. It should be noted that the above examples of superordinate and negation inferences from Frederiksen's taxonomy fail the but not test, since neither,

The dog chased the cat, but the animal didn't do anything.

nor,

Mother will get mad, but she will get mad.

is acceptable.

The generality of the but not test, as originally formulated, is limited since it treats sentences in isolation, and tests only whether one sentence is implied by another. However, the test can easily be extended. In connected discourse, it is often the case that an implication is the joint product of several sentences rather than the derivative of a single sentence. For example, examine the story in Figure 1 about a career woman about to leave on a business trip. This story is one version of one of the stories used in the studies to be reported here. The numbers and underlining have been added to permit easy indexing of key portions of the text. At (1) the woman has just enough time left to catch her plane. As she

packed (2), she remembered that she was supposed to speak to her son. Later in the passage, at (3), it is clear that she arrived quite late at the airport. The invited inference is stated explicitly at (4), but was deleted from the implied passage versions used in the studies. Clearly this implication is based on information spread throughout the passage. If the but not test is generalized to permit compound premises, then the invited inference can be shown to be a pregmatic implication because,

> A woman had just enough time to reach an airport for a flight. She remembered that she was supposed to talk to her son. She arrived late at the airport, but not because she had talked to her son.

passes the but not test.

The inferences to be studied in the experiments reported in this paper are pragmatic inferences by this broadened definition.

Current Research on Inference

Research on inference currently includes the study of the development of inferential processes in children (e.g., Paris, 1975; Paris & Lindauer, 1976; Brown, 1975), the formal representation of inferences in discourse analysis (e.g., Frederiksen, 1972, 1975c; Crothers, 1972; Kintsch, 1972, 1974) and computer simulation of human inference (e.g., Schank, 1972; Charniak, 1975; Collins, Warnock, Aiello & Miller, 1975). No attempt will be made to provide an exhaustive review of all areas of this research. Rather, this section will be focused on inferences made by adult humans in comprehension and memory with sentences and connected discourse.

Figure 1

A Career in Sales*

Joan dragged out her suitcase and began the well-practiced ritual of packing for a trip. (1) She had just enough time left to pack and get to O'Hare Airport in time for her 2 o'clock flight to San Francisco. It had been three years since her divorce, and she had spent much of that time on the road. Her new career not only permitted her to do the traveling she'd missed as a housewife and mother, it forced her to do it. At first it was terribly exciting jetting all over the country, seeing new regions, cities, and towns. San Francisco was one of Joan's favorite cities. She had fallen in love with the hills and the Bay, and had made several good friends there. By now, though, some of the glamour of constant travel had been lost to the repetitious drudgery of packing and unpacking, and of taxi rides to airports and hotels.

Fortunately, Joan still liked her career. She'd never had a real job before, since she'd married right after college and had never worked outside of her home. She'd been a business major in college, and she was happy to find a job in sales with a plastic home products firm. But she had certainly never expected her career to bloom so rapidly. She had done so well the first year that she had been promoted to a national sales trainer. She enjoyed helping trainees and keeping seasoned salesmen up to date on new products and promotional developments. Lately, however, the frantic pace of the job and jet lag had begun to wear on her.

Joan was well adjusted to the divorce by now. Her job kept her too busy for regrets, and she met and knew too many people to be really lonely. She was grateful to her ex-husband for agreeing to keep the children. It was the logical solution, since she wanted to be free to pursue her career, and because he had remarried and could give them a better home. Joan was so wrapped up in her work that she hadn't seen the children much lately. (2) As she finished packing Joan remembered that she had promised to talk to her oldest son before she left town. He was thinking of transferring to another college. She thought of her own college days while she gathered up her toothbrush and other essentials and stuffed them into her travel kit.

(3) O'Hare was as busy as ever when Joan arrived one-half hour late at 2:30. (4) She was late because she'd stopped to talk to her son. She exchanged her ticket on the 2 o'clock flight she missed for standby on the 3:30 p.m. flight. (5) When she arrived in San Francisco she learned that her original flight had unexplainably lost altitude and crashed into the mountains north of Denver. There were no known survivors. Joan contemplated the strange twist of fate that saved her life. She shuddered as she thought of the death she so narrowly escaped. During the taxi ride to her hotel, Joan thought about her new career and her old life.

*This is the important stated salient version of Passage 1 used in Experiments I and II. Numbers and underlining have been added to permit easy indexing.

The bulk of this research, including the work of the Bransford group (c.f., Bransford & Johnson, 1973; Bransford & McCarrell, 1974) and Brewer and his colleagues (e.g., Brewer, 1974; Harris, 1974; Brewer & Lichtenstein, 1975; Schweller, Brewer & Dahl, 1976) bear witness to a single fact: that inferences do indeed occur when people read (or hear) and remember sentences or text. These demonstrations of the occurrence of inference have established inference as a major component of how people understand and remember verbal messages, and have played an important role in ending the long history in psychology of the purposeful neglect of constructive processes. In this sense, recent research has succeeded where Binet and Henri and Bartlett failed. This research also serves the further purpose of demonstrating and establishing the range of the phenomena. For example, by showing that subjects tended to recall,

The truck driver asked the waitress for some coffee.

when they had read,

The truck driver told the waitress that he wanted to have some coffee.

and often recalled or falsely recognized,

The angry farmer frightened the boys.

after reading,

The angry farmer frightened the trespassing boys.

Schweller, Brewer, and Dahl demonstrated pragmatic inference in recall and recognition for the illocutionary and perlocutionary force of statements.

While these demonstrations have served a vital role, the occurrence and importance of inferential processes is by now firmly established, and the time has come for research to move beyond demonstrations to explorations

of how inferences work. So far, little research has been directed at detailing the controlling variables and processes of inference. One question which has been the subject of much recent study is whether inference occurs at comprehension or at recall. The next section presents a discussion of this issue.

When do inferences occur? Perhaps the most direct attack on the question of when inference occurs is the verification latency experiments of Kintsch (1974) and Singer (1976, 1977) in which reaction times for the verification of statements implied by a text are compared to those for statements which were explicitly stated by the text. The rationale for these studies is that if inference occurs at comprehension, then the verification time for implied statements should not differ from explicit statements. If inference occurs at test, then the verification of implicit statements should take longer. Kintsch reports a series of three studies which he conducted with Keenan and McKoon. The first two studies employed short, two-sentence passages and longer texts. The short passages were constructed with the intent that the inferences would be required at reading in order to comprehend and integrate the paragraph. The inferences studied included implied causation such as,

A burning cigarette was carelessly discarded.

The fire destroyed many acres of virgin forest.

which implies,

A discarded cigarette started a fire.

The longer passages varied in length from 40 to 120 words and dealt with obscure facts. For both short and long paragraphs, explicit versions, which were identical to the implied versions except that they contained a

statement of the content of the implied proposition, were also employed.

In all of these studies, subjects were presented with sentences and instructed to decide whether they were true or false based on information stated or implied in the passage. The crucial inference questions were always true, but false filler items were included. In the first study, subjects were tested immediately after each passage. Kintsch reasoned that subjects would construct the same propositional representation regardless of whether they had seen the explicit or implicit version of the passage, and that verification would be based on this propositional representation. He therefore predicted that there would be no differences between verification latencies for implicit and explicit statements. Contrary to Kintsch's hypothesis, implicit versions led to higher error rates as well as longer latencies for correct (affirmative) responses than explicit versions.

Kintsch argued that the disadvantage of the implicit material was not caused by failure to generate inferences at reading. Rather, the explicit passage versions were said to produce a surface representation of the information, as well as the underlying propositional representation. Only the propositional representation was available to subjects who read the implicit versions. After reading the explicit version, subjects could match the probe against the surface representation more quickly and reliably than subjects who read the implicit version could verify the probe against the propositional representation.

Kintsch reasoned that if the advantage of the subjects who read the explicit versions was indeed due to the persistence of a surface representation, a delay before the test sufficient to ensure the loss of the surface representation would negate this advantage. In the second study,

subjects read all the passages followed by a 15-minute interpolated sentence memory task, and finally, the verification test. This time the results supported the prediction: there was no difference between the verification latencies for implicit and explicit versions, although a non-significant trend toward lower error rates for explicit versions persisted.

The third study replicated and extended this result by varying the retention interval, using 0, 30-second, 20-minute, and 48-hour delays. Orthogonal tests collapsing across the two short and two long retention intervals revealed that at 0 and 30 seconds, explicit questions were verified more quickly than implicit questions, but that no significant difference was found at 20 minutes and 48 hours.

The results of the three studies reported are consistent with the hypothesis that the inferences occurred at encoding, provided it is assumed that verification is consummated when there is a match on either surface form or propositional content, with the former being faster. However, there are several weaknesses in the designs of the studies, and alternative explanations are possible. In the first two experiments, explicit versions were not only longer than the implicit versions, but also syntactically more complex and less readable. In the third study, the inferential status of test items was confounded with the content, as a particular item was either implicit or explicit. Although Kintsch invokes stored surface information as the cause of the more rapid verification of explicit items, examination of the materials reveals that, at least for the first experiment, test items were <u>not</u> verbatim copies of anything in the original passages. The use of a delayed test in order to eliminate memory for surface information as a factor leaves open the possibility that the failure

to find a difference between stated and implied items may have been due to the forgetting of explicitly stated information. If there were forgetting of the propositional representation, or meaning, the subjects would be unable to verify even explicit items by directly matching them to the propositional representation, but instead would have to infer them from a skeletal representation. Similarly, subjects might have to infer implied statements at a delayed test, whether or not they had previously been inferred. A better control for surface information would be to systematically vary the similarity of the test item to the surface form of the explicit version.

Despite the similarity between the studies of Kitsch and Singer, their results stand in direct opposition. Singer (1976) found that 10 seconds after reading sentences like,

The small girl spent the gleaming penny.

subjects were able to verify sentence like,

The penny was shiny.

which were paraphrases of portions of the study sentences, more rapidly than they could verify inferences like,

The penny was new.

This result obtained despite the fact that the paraphrase and the inference were matched in terms of surface similarity to the original sentence.

In a second paper (1977), Singer reported three experiments which tested both recognition, where subjects were to indicate whether the test sentence was identical to a study sentence, and verification. Test items like,

The sailor swept the floor with the broom.

were presented following a three-sentence passage that began either with a verbatim copy of the test probe in the explicit version or a sentence like,

The sailor swept the floor in the cabin.

in the implied version. In the first study, subjects heard 12 experimental and eight filler passages before being tested. No difference was found between the acceptance rate for stated and implied items, but implied items took significantly longer to confirm. In the second study, subjects were tested six seconds after hearing each passage. In this study, acceptance rates were much higher for explicit items, especially on the recognition test. Again, explicit items were accepted more rapidly than inferences. In both studies, the reaction time difference was consistent across recognition and verification tests. The final study compared the verification of inferences with explicit items which were paraphrases rather than verbatim copies of the first sentence of the passage. Thus, for the above example, the explicit version contained the sentence,

The sailor used the broom to sweep the floor.

while the implicit version and test item remained unchanged from the previous studies. Subjects heard all the passages before the verification test of six experimental and six false filler items. While there was no difference in the acceptance rates, explicit items were again verified more rapidly. Singer concluded that since, in his studies, inferences always took longer, even when the test was delayed and when the explicit items were only paraphrases of the original passage, at least some portion of the inferential processing must occur at test. Singer took the difference between explicit and implicit verification times, about 200 milli-

seconds, as an estimate of the time required for this additional processing.

Although Singer's results seem to indicate some inferential processing at test, his interpretation of the reaction time difference as a measure of the time taken for such processing rests on one rather tenuous assumption: that reaction times averaged across subjects or across items are truly representative of each subject or item. An alternative interpretation is that a subject makes the inference at comprehension for some proportion of the implied items, and on those items verifies the test sentence as rapidly as if it had been explicit (ignoring for the moment the possibility of faster verification for explicit items due to a surface level match). For the remainder of the implied items, the subject fails to make the inference at comprehension and must make it at test, producing a slower verification than for explicit items. Thus, verification times averaged across subjects or items would reflect the proportion of items for which subjects failed to make the inference at comprehension, as well as extra processing time required when the failure occurs. Further, only in the initial study was surface similarity between the study sentence and test probe controlled. In the first two experiments of the more recent paper, the test item was a verbatim copy of the explicit version. In the third experiment, although the syntax of the sentence was changed in order to alter word order between the explicit version and the test item, the lexical form of all content words was identical for both versions. Thus, in all three of these experiments, the faster verification of explicit items could be explained in terms of a better match between the surface form of the explicit study items and the test sentences.

While it is not clear how to reconcile the disparity between the results of Kintsch and Singer, the picture is complicated still further by a third line of studies which has produced an entirely different result. The linear ordering studies of Potts (e.g., Potts, 1972; Scholtz and Potts, 1974) have consistently shown that statements which were never presented were actually verified more rapidly than copies of the statements which were presented. In this research, subjects studied a series of comparative statements which permitted the ordering of a list of items on their value on some dimension. Statements which compared two items which varied widely on the dimension were verified more rapidly than close comparisons, regardless of whether or not they had been presented.

Frederiksen (1975a) employed a very different approach to the problem. He reasoned that if inference was a vital part of the comprehension process, then the appearance of inferences in recall should increase with repeated exposures to a passage, since each rereading would provide an opportunity for further inferencing. If, on the other hand, inferences are produced at recall merely to fill up gaps in memory, then the appearance of inference should decrease with repeated readings of the text, since as subjects learned more of the text, they would have fewer gaps to fill. In the study reported, and another study (1975b) discussed below, Frederiksen obtained results which he interpreted as supportive of the inference-at-comprehension hypothesis, since no effect of trials was obtained. Interpretation of this result is complicated by Frederiksen's scoring system, particularly by his distinction between inferred and elaborative material. Only statements "necessarily implied" by the text were classified as inferential, thus, some of the elaborations were probably pragmatic inferences, and elaborative material actually showed a significant decrease across trials. However, even if a significant increase

in inferences across trials were found, this would not unequivocally support the inference-at-comprehension position. Suppose that inference occurs at recall. Since inference depends upon both information in the text and extra-textual knowledge, if the subject is able to remember more of the text at recall, he will have a better base for inferencing, and may therefore produce more inferences.

The study by Spiro (1975), which will be discussed in more detail in the next section, clearly demonstrated constructive processes which occurred after comprehension, since they were produced by a manipulation which occurred after subjects had finished reading the passage. The study demonstrated that constructive processes can occur after comprehension, but does not bear on the issue of whether inferences normally occur at comprehension or output.

In summary, the verification latency experiments have produced conflicting results, each of which is open to alternative explanations, and have made little or no progress toward resolving the issue of when inferences occur. The studies by Frederiksen and Spiro also fail to fix the temporal locus of inferences at comprehension or at recall. Perhaps the question itself is miscast: it seems most unlikely that inferences occur only at comprehension or output. A better approach might be to assume that inference can occur at either time, and to study variables which control whether or not inferences will be made at comprehension, or that influence inferential processes at output. The previous research can be interpreted to show that inferences are likely to occur at comprehension if they are essential to comprehension (Kintsch, 1974), or if study instructions and conditions favor elaborative processing (Potts, 1972; Scholtz & Potts, 1974;

Frederiksen, 1972, 1975b). They will occur during retention or at test if they did not occur at comprehension, and enough of the text is remembered to provide the basis for inference, or if ancillary information or test questions cue them (Singer, 1976, 1977; Spiro, 1975).

Although the studies reported in this paper do not directly address the issue, it seems likely that importance as manipulated in these experiments may affect when inferences occur. It seems reasonable that the effect of importance would be to increase the probability that a subject will make an inference at comprehension. An output explanation of the effect of importance on inference is possible, however, since importance might act to increase the probability that the subject will remember the explicit information upon which an inference is based, thereby increasing the probability that the inference can be made at the test.

Investigations of Variables Which Control Inference

Task manipulations. The most direct task manipulation is simply to vary the instruction or the task by which subjects are tested. Thus as discussed above, Gauld and Stephenson (1967) were able to greatly reduce the number of consturctive productions in discourse recall by instructing the subjects to write down only what they were certain was contained in the original passage. Taking the opposite tack, Brockway, Chmielewski, and Cofer (1974, Experiment 1) had subjects read two brief passages (similar to those of Frase, 1969) and then, in separate tasks, the subjects were asked to recall the passage and to generate statements about the passage which were "logical extensions or conclusions, or ideas compatible with the paragraph, or associations of any type" (p. 197), but could not

include sentences repeated or paraphrased from the text. Independent raters judged the generated statements to be reliably less related to the text than the free recall.

Singer (1977) found that subjects gave more affirmative responses to inferences, as well as explicit items, when they were asked to judge the truth of a statement (verification test) than when they were asked to indicate if a sentence had appeared in a passage (recognition test). When the test followed immediately after the passage (Experiment II), the difference between acceptance rates in verification and recognition tests was much greater for inferences than for explicit items. Brockway, Chmielewski, and Cofer (1974, Experiment II) found that subjects produced more affirmative responses to generated statements related to the original passage when told to indicate whether statements were inferable from the passage or when asked to decide whether statements were consistent with the passage than when they were to decide if the statement had actually occurred in the passage.

The effect of varying instructions at comprehension has been studied by Frederiksen (1972, 1975b) and Spiro (1975). Frederiksen presented subjects with a 500-work passage adapted from Dawes (1966) with instructions simply to learn it for a memory test, to think about solutions to problems stated in the passage while learning it for a memory test, or simply to think about solutions to the problems. Subjects who received the first two sets of instructions recalled the passage after each of four readings. Subjects who received the third set of instructions were not tested until after the fourth reading. All subjects were given a surprise delayed recall, one week later. Frederiksen found some evidence, beginning

with the second test, that subjects who received the problem solving plus memory test instructions produced more inferences than subjects who received the memory test instructions. After four readings and at delayed recall, the proportion of recalled material scored as inferential was higher for the two problem solving groups than for the memory test only group.

Spiro (1975) told subjects either that they were in a memory experiment or that they were in an experiment concerning reactions to interpersonal relations and then had subjects read a story about an engaged couple, part of which discussed the feelings of each person regarding children. Some of the subjects read a version of the passage in which the couple was in total agreement to forego a family, while other subjects read a passage version in which disagreement over the issue began a heated debate. Several minutes after reading the passage, some of the subjects who read each version were casually informed that the couple got married and lived happily ever after, others were told that the couple had called off the engagement and had never seen each other again, while the remainder were told nothing of the outcome of the story. All subjects were later given a recall test for the passage after a delay of 2 days, 3 weeks, or 6 weeks. Some of the subjects received a story and subsequent information about the couple which described a scenario which was "balanced" (Heider, 1958) in that it was consonant with knowledge and expectations about interpersonal relations, while for other subjects the scenario was unbalanced. Spiro was able to predict the sorts of constructive processes which would be invoked to resolve the imbalance. Of more interest here, however, was the prediction, confirmed by the results, that the inter-

personal relations experiment cover story would produce many more constructive errors. This result obtained because subjects who thought they were in the interpersonal relations experiment were more likely to engage their knowledge of interpersonal relationships than were subjects who were trying to memorize a passage for a memory experiment.

Taken together this research clearly and consistently shows a strong effect of instructions and task on inferential processes.

Text manipulations. To date, only Thorndyke (1977, 1976) has studied the effect of passage organization on inference. In the first of these studies (1977), organization was varied by presenting a statement of the theme at the beginning or end of a story, by deleting the theme, or by using a descriptive passage devoid of the temporal and causal relationships present in the stories. The sentences of the passages were then presented in normal or random order. Thorndyke found that subjects who read the more highly organized passages were more likely to falsely recognize items which could be inferred from the text but had not been explicitly stated.

Thorndyke (1976) has also investigated the effect of varying the plausibility of an inference. Thorndyke prepared passages in which an inference-priming sentence such as,

The hamburger chain owner was afraid his love for french fries would ruin his marriage.

was followed later by a continuation sentence which increased the plausibility of a likely inference (the "experimental" condition) or by a continuation sentence which did not affect plausibility (the "control" condition). Thus, when the experimental continuation,

The hamburger chain owner decided to join Weight-Watchers in order to save his marriage.

followed the inference-priming sentence shown above, the plausibility of the appropriate inference,

The hamburger chain owner was very fat.

was increased, while the plausibility of the inappropriate inference,

The hamburger chain owner's wife didn't like french fries.

was reduced. The plausibility of the neutral inference,

The hamburger chain owner got his french fries free.

was unaffected. On the other hand, when the inference-priming sentence was followed later by the control continuation sentence,

The hamburger chain owner decided to see a marriage couselor in order to save his marriage.

the plausibility of all three inference types remain unchanged. Thorndyke's first study (1976, Experiment I) showed that, when asked to write inferences, subjects who read the experimental passage version more often produced the appropriate inference than the neutral inference, and less frequently produced the inappropriate inference. Plausibility ratings reflected the same effect: the appropriate inference was rated most plausible and the inappropriate inference was rated least plausible. Subjects who read the control passage version produced all three inference types equally often and rated them equally plausible. The second study tested recognition. Subject were instructed to respond affirmatively to those items explicitly stated in the passage and to reject items which could be inferred. The false recognition rate for subjects who read the experimental passages was highest for appropriate and lowest for inappropriate inferences. No

differences obtained for subjects who read the control versions.

These studies represent a solid beginning to the investigation of the effect of text variables, but they are clearly just a beginning. The effect of most text variables upon inference has yet to be subjected to informed speculation, let alone empirical investigation. A great deal of research has shown that the important aspects of texts are remembered while less important aspects are forgotten. Importance, whether measured by subjective ratings or text structure analysis, has proven to be a powerful determinant of the recall of explicitly stated material in text. It seems reasonable that it should also affect inference.

Importance: An Important Text Variable

The effect of importance on memory for text. The early research on memory for connected discourse of Binet and Henri and others soon revealed that when a group of subjects recall passages, some elements of the passages are recalled by most subjects, while other elements are recalled by almost no one. The items which most subjects recalled were judged by the researchers to be more closely related to the theme of the passage, or more important. For example, Newman (1939) tested recall immediately after reading a passage or after a retention interval of several hours of sleep or waking. He found that "essential" story elements were better recalled at the immediate test that "unessential" story elements, and that the essential elements showed much less forgetting across the longer retention intervals. Gomulicki (1956) investigated the immediate recall of prose passages from 15 to 200 words. He found that although subjects were able to recall the shorter passages verbatim, they were only able to recall the more important aspects of the longer passages.

Johnson (1970) developed a direct method of measuring importance. Subjects were presented with a text that had previously been segmented into pausal units (units between which pauses would be acceptable) and told that while some of the units were central and essential to the passage, others were of little importance and could be deleted with little or no damage to the passage. The subjects were then told to indicate those units which were least important and could therefore best be deleted. Different groups of subjects were told to delete 1/4, 1/2, and 3/4 of the pausal units, and the number of subjects who deleted a given unit became the measure of importance. The passage was then administered to a second group with instructions to learn it. Importance was found to be a strong determinant of recall over retention intervals ranging up to 63 days.

A systematic, formal account of importance came with the development of text structure models. Meyer and McConkie (1973) used a simple and intuitive method of discourse structure analysis. They had graduate students outline a passage, and then converted the outlines to tree structures. From these tree structures, three measures of the importance of an idea unit in the structure of the passage were developed: a hierarchy depth score, which measured how high in the hierarchy the unit occurred; a units beneath score, which measured the number of units which were beneath the given unit in the hierarchy; and a combined hierarchy score, which combined the above two measures, equally weighted, into a single, unified measure. Significant effects upon recall were found for all three measures. Further, when significant effects of serial position and rated importance were found, these turned out to be largely due to the correlation of those factors with hierarchical importance.

Kintsch has replicated the results of Meyer and McConkie (1973), using his more formal proposition description. Kintsch's (Kintsch & Keenan, 1973) propositional rank is essentially equivalent to Meyer and McConkie's hierarchy depth score, and Kintsch's counting of descendant propositions is analogous to Meyer and McConkie's units beneath score. Using Kintsch's system, McKoon (1977) was able to demonstrate that important items are better recognized than unimportant items.

Both Meyer and McConkie (1972) and Kintsch and Keenan (1973) tested the effect of importance using different portions of the same passage with different importance values; therefore, importance was confounded with the material involved. Meyer (1975) eliminated this confounding by writing two versions of a passage such that a target paragraph, which occurred in identical form and position in each passage version, was very important in one version, and quite unimportant in the other version. Importance was determined by height in a hierarchical text structure derived by an analysis system based on a propositional text grammer which Meyer had developed from Grimes' (1975) system. Again, importance aided recall, since the target paragraph was better recalled when it had been presented in the passage version in which it was important. The effect of importance was strong and significant on an immediate recall test, and a one week delayed free recall revealed that the target passage suffered less forgetting when it was important.

Similar results have been found using the story grammar method of discourse analysis developed by Rumelhart (1975). Story grammars have been developed to provide a schema-theoretic account of text structure (see Rumelhart & Ortony, 1977). Rumelhart (1977) analyzed stories into

hierarchical structures and presented them to subjects who had to recall or summarize them. Those story elements which were more important in terms of position in the hierarchy were more likely to be recalled or included in summaries.

Importance and levels of processing. Although little attention has been paid to the explanation of why important materials are better recalled, one possibility is that subjects identify the important elements of the passage and spend more time or effort encoding those elements. The levels of processing notion of Anderson (1970, 1972) and Craik and Lockhart (1972; Craik, 1973) can be applied to explain better recall of important elements in terms of deeper or more meaningful encoding.

Important elements are semantically encoded and elaborated into a rich and durable memorial representation. Unimportant elements are, in general, processed only to the depth necessary to determine that they are relatively unimportant, and are, in any case, not as deeply or elaboratively processed as the important elements. The skilled reader, realizing that he or she has a limited processing capacity and cannot deeply encode all the information in the text during reading (Frederiksen, 1972, 1975a, 1975b), identifies an abstract (Gomilicki, 1956) or core of important material for deep encoding. Since important elements are more deeply encoded, they are less subject to forgetting, an advantage that increases with the retention interval (e.g., Newman, 1939; Meyer, 1975).

However, more semantic, eleborative processing of important materials should lead not only to better memory for the material that was explicitly stated, but also to increased inferential processing. I have argued throughout this paper that readers cannot draw all possible inferences,

just as they cannot deeply encode all the explicit material. Therefore, the reader will select the important elements for inferential elaboration, or, put another way, the reader will be more likely to make an inference if it is important.

Pichert and Anderson (1977) offer a slightly different account of the effect of importance: they argue that subjects encode text by using it to instatiate or fill the slots in preexisting knowledge structures called schemata. Important material is important and better remembered because it fills a slot in the schema that is being instantiated during reading. By this account, important inferences would be made in order to fill slots left unspecified in the text.

Importance as an inherent aspect of text: Some snags. A common feature of discourse structure analyses, including those of Kintsch and Meyer, as well as others such as Frederiksen (1972, 1975c) and Crothers (1972) is that they treat text structure as though it were an inherent attribute of the text. Thus, Kintsch and Meyer derive a measure of the importance of an element of a text from the position of that element in the structure of the text. Such an approach can only be psychologically adequate if the meaning of text is in fact invariant across subjects and contexts. These researchers almost certainly never meant to imply that context and subject factors could be ignored in the representation of text, and the implication is surely false. Bransford and Johnson (1972) and Schallert (1976) have demonstrated the importance of context. Bransford and Johnson showed that a vague, opaquely written passage which in isolation seemed nonsense and was very poorly recalled could become perfectly sensible and easily recalled when given the proper title or illus-

tration as context. Schallert showed that the same ambiguous passage could be given two very different meanings when preceded by different title contexts.

Anderson, Reynolds, Schallert, and Goetz (in press) used ambiguous passages similar to those of Schallert (1976) to show the effect of reader interest and knowledge on the interpretation of text. They found, for instance, that upon reading a passage that was ambiguous between a description of a card game and an account of an instrumental quartet practice, music students were far more likely to construct the latter interpretation than were physical education students. Pichert and Anderson (1977) have demonstrated the effect of reader perspective on the rated importance and recall of idea units in text. One of their passages was a story about two boys who played hooky from school and went to play at the home of one of the boys. The passage contained some information which would be of special interest to a prospective home buyer (e.g., information about new house siding, a fireplace, and a damp and musty basement), and other information which would be more likely to interest a burglar (e.g., information about the existence and location of 10-speed bicycles and a color television, and the fact that no one was home on Thursdays). A rating study was conducted in which different groups of subjects were asked to read the passage and rate the importance of idea units from the perspective of a home buyer or from the perspective of a burglar. A control group was told nothing about perspective. If importance were an inherent aspect of text, as implied by existing text analysis systems, then assigned perspective should have had no effect on rated importance and the rank order correlation of the rated importance of

idea units between groups should have approached +1. This prediction was clearly disconfirmed by low intergroup correlation. In a related study, subjects who had been assigned to one of the perspective conditions read the passage and later recalled it. The importance ratings from a given perspective were the best predictors of the recall of subjects who read the passage from that perspective.

The Present Study

Two experiments are reported in which the effect of importance was tested. Although differences between the knowledge and interests or perspective of readers were emphasized in the research of Anderson et al. (in press) and Pichert and Anderson (1977), there is also a large body of knowledge, opinion, and belief which is shared by most members of a culture. Importance can be manipulated by tapping these commonalities. For example, most persons view a fatal plane crash as more important than a routine weather delay. Therefore, an action or event which prevents a person from boarding a doomed plane is likely to be viewed as more important than if the same action or event merely reduced the time spent waiting for a delayed flight. Importance was manipulated in this manner in the experiments that are reported in this paper.

In the present studies, important and unimportant passage versions were constructed so that the plausibility of the inference, which was investigated by Thorndyke (1976), did not vary. In the story about the businesswoman, the cause of her tardiness (4) is quite important in the version shown in Figure 1, since this event saved her life by making her miss a flight that crashed (5). By contrast, this implication is much less significant in the unimportant version in which it merely reduced her wait

for a delayed flight. The fact that the plane crashed in the important version, however, did nothing to affect the plausibility of the invited inference, that she was late because she stopped to talk to her son, since whether a plane crashes or runs behind schedule is not related in any systematic way to whether a potential passanger is late due to family discussions, traffic problems, chance reunions with old friends, or any other possible cause of lateness.

In addition to importance, two other variables were studied. Salience of the premise was varied by changing the amount of detail or emphasis given to the material that cued the specific target inference. Explicitness of the target was varied in order to provide a control condition in which the target had been explicitly stated.

In Experiment I, recognition was tested using a four-alternative multiple-choice test. After selecting an answer, the subject rated the closeness of this answer to the original passage. The major prediction was that importance would increase the probability of an inference being made. This would be reflected by a greater proportion correct on the implied target questions for important passage versions than for unimportant versions. A similar effect of importance was predicted for subjects who read the stated versions, as this result would replicate McKoon (1977) and be in line with the results obtained by Johnson (1970), Meyer and McConkie (1973), and Kintsch and Keenan (1973). Further, for those inferences correctly recognized, it was predicted that the subject would be more likely to rate important inferences as having occurred in the passage, which would be consistent with the interpretation that the effect of importance was to increase the probability that an inference would be made at encoding.

Salience of the premsie should only have an effect when the target must be inferred, so a significant effect of salience was predicted only for subjects who read implied versions.

Recognition of premise material and material varied to create the importance manipulation was also tested, and the conditional probability of answering the target question correctly given that the premise and/or importance manipulation question had been answered correctly was computed. If an effect of importance were found, one possible explanation would be that importance served to improve the probability that an inference could be made at test by raising the probability that a subject would retain at test the information needed to make the inference. If this were true, recognition of the premise material should be better for important than unimportant versions, but the probability of correctly answering the target question, conditional upon a correct answer to the premise question, should be unaffected by importance. The conditional probabilities were used to examine this and other hypotheses.

Filler questions which tested memory for material unrelated to the inference were also included. If the effect of importance was to increase the interest and memorability of the entire story, these filler questions would also show the importance effect. No effect was predicted.

Experiment II was a replication of Experiment I using a cued recall test. All major predictions were the same for Experiment II as for Experiment I.

CHAPTER II

EXPERIMENT I

Method

Design. A six-way mixed factorial design was used with importance of the target (important vs. unimportant) as the within-subjects factor, and salience of the premise (high vs. low) and explicitness of the target (stated vs. implied) as between-subjects factors. Two subject status variables were analyzed, grade level (ninth and tenth graders vs. eleventh and twelfth graders), and verbal ability (low vs. high). Subjects were assigned to verbal ability conditions independently for the two grade levels. List (A vs. B) was a between-subjects factor used to counterbalance importance with passages.

Subjects. The subjects were 184 high school students from a rural east Central Illinois high school with an approximate enrollment of 220. They were run in groups of 15 to 30 students.

Materials. Six sets of passages were created such that all passage versions within a set shared the same target inference. The passages, ranging from 500 to 520 words in length, were all fictional stories. Each passage set consisted of eight passage versions, one for each combination of importance, salience, and explicitness. Passage sets were constructed so that within a set the target inference was always the same and the various versions were as similar to each other as possible, given the changes required by the experimental manipulations. For example, for Passage Set 1, the important salient stated version of which is shown in Figure 1, the only difference between stated and implied versions is that the former includes an explicit statement of the target inference:

She was late because she'd stopped to talk to her son.

shown at (4) in Figure 1, which does not appear in the implied versions.

The important and unimportant versions differ only in the final paragraph and only to the extent necessary to vary the importance of the target inference. In the important version of Passage Set 1, the main character misses her original flight which, she later discovers, crashes into the mountains killing all aboard. Instead of this material, which appears at (5), the unimportant versions state that:

> She was told that her flight had been delayed in New York and would not depart until 3:30 p.m. To kill the time, she stopped off at the coffee shop for a late lunch and a copy of Business Week magazine. During the flight she studied some material on a product introduced only the day before. When she arrived in San Francisco, a misty rain was sweeping in off the bay.

Thus, in the important versions, the inference that she took time out to talk to her son is important because this act saved her life. In the unimportant version, the only effect of her talking to her son is a reduction in the time she spent waiting at the airport. For each passage set, important and unimportant versions were matched for the number of words.

Salience of the premises was also manipulated. Thus, at (2) in the highly salient version of Passage Set 1, the main character remembers that she had promised to talk to her son. By contrast the less salient versions state that:

> As she finished packing, Joan remembered that her oldest son had wanted to talk to her before she left town.

Important and unimportant versions of different passage topics were randomly assigned to lists: the important versions of Passages 1, 2, and 5

and the unimportant versions of Passages 3, 4, and 6 appeared in List A; the unimportant versions of Passages 1, 2, and 5 and the important versions of Passages 3, 4, and 6 appeared in List B. Study booklets containing a passage from each passage set were constructed from both lists for each of the four combinations of salience and explicitness. Within the study booklets, passages were ordered using ten random orders selected under the following constraints: (a) for any order, no more than two important or two unimportant passage versions occurred consecutively, (b) across all ten orders, each passage topic appeared in each position at least once and not more than twice, (c) across all ten orders, important and unimportant versions appeared equally often in every position.

Five four-alternative multiple-choice questions were prepared for each passage set. The questions for Passage Set 1 are shown in Figure 2. Each set of questions included one target inference question, one or two premise questions, a question which covered the information that was included in the importance manipulation, and as many (one or two) unrelated filler questions as were needed to bring the total to five. The target questions querried the inferences which are the focus of the passages. The premise questions related to the information which pointed toward the target inference, and the importance manipulation questions covered the part of the story which was changed in order to manipulate the importance of the target. The questions appeared one to a page in test booklets in which the questions for each passage were blocked together. For each subject, the blocks repeated the order of the passages in the study booklet. Within blocks, the order of the questions was the same for all subjects, with the target question always first and the importance manipulation question always last. Each

Figure 2

Recognition Questions for Passage Set 1,

A Career in Sales

Experiment I

Target Question

1.* Joan was late to the airport because:

a. she got a call from her exhusband.

b. she ran into some old friends.

c. she got caught in traffic.

d. she had to speak with her son.

Premise Questions

4. As Joan finished packing she remembered:

a. That she was expecting a call from her husband.

b. that she and her son were supposed to have a talk.

c. that she had to call the airport to confirm her reservation.

d. that she had to call her friends in San Francisco.

3. When Joan started packing:

a. she barely had enough time to make it to the airport.

b. she had plenty of time to pack before her flight.

c. she knew that she would be late to the airport.

d. she realized that she had already missed her flight.

Figure 2 (Continued)

Importance Manipulation Question

5. Joan's original 2 o'clock flight to San Francisco:

   a. departed late due to a delay in New York.

   b. departed late due to fog at O'Hare.

   c. crashed into the mountains north of Denver.

   d. crashed during takeoff at O'Hare.

Filler Question

2. Joan's career in sales:

   a. was moving ahead just as she had planned.

   b. was lagging behind her expectations.

   c. had progressed much faster than she had expected.

   d. had recovered somewhat after a shaky start.

*Numbers indicate the order in which the questions appeared in the test booklet.

question was immediately followed by the following 4-point scale on which the subject was asked to rate how close the answer he or she selected was to the original story:

1. Exact quote from the story
2. Paraphrase of the story
3. Directly implied by the story
4. Consistent with the story.

This rating was included because the comparison of greatest interest was between important and unimportant versions for the implied target questions. Traditional recognition is not ideally suited to this comparison, since it was developed to test the ability to correctly identify stimuli which have previously been encountered, and in the present case, the subject had not seen the target in either condition of the comparison of interest. If subjects make inferences at reading, they should be more likely to think the inferences were stated in the original passage than if they make the inference only at the test. The prediction was that the subjects would be more likely to make inferences during reading if they were important, and that this effect would be reflected in their ratings.

The Wide Range Vocabulary Test (French, Eckstrom, & Price, 1963) was used to assess verbal ability.

Procedure. The study instructions directed the subjects to read and think about each story, since they would later be given a test. Following instructions, subjects were given 3½ minutes to read each story. At the conclusion of the sixth story, the Wide Range Vocabulary Test was administered. Subjects were told that there would be no penalty for guessing, and that they should not spend too much time on any one item since they probably would not

have enough time to finish. The subjects were given 4 minutes for the test. Finally, the subjects were given the recognition test. The subjects were instructed to select the answer they thought was correct based on the story, and to choose an answer for every question, even if they had to guess. They were also asked to rate how close the answer they selected was to the original story on the rating scale printed beneath each question. Subjects worked at their own pace, but were enjoined to answer the questions in order without looking ahead or going back.

Results

Three types of measures were analyzed: (1) proportion correct, (2) conditional probabilities, and (3) ratings. Unless otherwise stated, all analyses of variance reported in this section were conducted employing a six-way mixed factorial design with subjects as the replication factor, grade level, verbal ability, list, explicitness, and salience as between-subjects factors; and importance as a within-subjects factor.

Proportion correct. Proportion correct scores were calculated for each of the four question types, target, premise, importance manipulation, and filler. In each case, two scores were calculated for each subject by collapsing across the three important and three unimportant passages. Significant effects for all four measures are summarized in Table 1. In all of the analyses, main effects were found for grade level and verbal ability, reflecting the fact that subjects from the ninth and tenth grades and those with low verbal ability scores answered fewer questions correctly.

Target. The focus of the study was to test whether manipulating the importance of an inference would affect the probability that it would be made. The proportion of target questions answered correctly provided the

Table 1

Summary of Significant F-values for the Proportion Correct Measure for the Four Question Types, Experiment 1

Effects[a]	Question Type			
	Target	Premise	Importance Manipulation	Filler
Importance of Target (I)			44.7**	
Salience of the Premise (S)	5.4*			
Explicitness of the Target (E)	32.7*			
Grade (G)	6.2*	12.5**	7.5**	5.3*
Verbal Ability (VA)	5.6*	4.7*	15.0**	4.9*
I x E	4.1*			
I x VA			9.4**	
I x List (L)	41.0**	4.2*	6.8**	
S x E	6.4*			
I x G x L				6.2*
I x S x VA			4.3*	
I x S x L				7.1**
I x E x L	8.8**			
S x E x VA	5.4*	4.2*		
S x E x G x VA	5.7*	12.2*		11.0**

*p < .05

**p < .01

[a]Degrees of freedom for all F-values were 1,152.

most direct measure of the hypothesis. Table 2 shows the mean proportion correct for each importance, salience, and explicitness condition.

The effect of importance (Important = .86, Unimportant = .83) was not significant overall. However, the major prediction was that importance would have an effect on the probability that an inference would be made. Since the target was only an inference for the implied condition, the critical test of importance applied only to the implied condition. Consistent with this prediction, a significant Importance X Explicitness interaction was found. Simple effects analyses of this interaction revealed that the important passages produced significantly higher scores than the unimportant passages for the implied condition (Important = .81, Unimportant = .74), $F(1,152) = 7.2$, $p < .01$. Thus, the importance of the target inference had a significant effect on the probability that the inference would be made. Importance had no effect when the target was explicitly stated (Important = .91, Unimportant = .92), $F(1,152) = 0.3$, possibly because of a ceiling effect.

As expected, target questions were more often correctly answered when they had been stated than implied (.92 vs. .78), and when the premise was highly salient than when the premise was less salient (.88 vs. .82). Simple main effects tests on the significant Salience X Explicitness interaction showed that the effect of salience was highly significant for the implied condition (Low = .71, High = .84), $F(1,152) = 13.6$, $p < .01$, and totally absent for the stated condition (Low = .92, High = .92), $F(1,152) = .02$. The Salience X Explicitness X Verbal Ability interaction reached significance, apparently because the Salience X Explicitness interaction held only for low verbal ability students.

Table 2

Mean Proportion Correct for the

Target Questions, Experiment I

Explicitness of the target	Salience of the premise	Importance of the target		
		Important	Unimportant	Total
Stated	High	.90	.93	.92
	Low	.92	.92	.92
	Total	.91	.92	.92
Implied	High	.88	.79	.84
	Low	.75	.68	.71
	Total	.81	.74	.78
Total	High	.89	.86	.88
	Low	.84	.80	.82
	Total	.86	.83	

Two interactions involving list may seem to cloud the issue. The Importance X List (Table 3A) interaction seems to indicate a reversal in the importance effect between lists. However, list was merely a counterbalancing factor, and, for either list, importance was confounded with passages. A consistent trend for importance was observed when the data were ordered by passages (Table 3B). The significant Importance X Explicitness X List interaction also can be traced to differences among passages, and is of no consequence. One fourth-order interaction reached significance.

Premise. For the analysis of premise questions, neither the importance nor explicitness of the target produced a significant effect. Surprisingly, salience of the premise had no effect on recognition of the premise. The only significant second-order interaction was the Importance X List interaction which resulted from a difference in the difficulty of the passage groups.

Importance manipulation. This analysis involved questions which querried the portion of the passage which was changed in order to manipulate the importance of the target. The proportion of these questions correctly answered was much higher for the important than for the unimportant condition (.93 vs. .79). The effect of list (A = .83, B = .89) approached significance ($p = .06$), while explicitness and salience were not significant.

The significant Importance X Verbal Ability interaction was subjected to simple main effects analyses which showed that the difference between high and low verbal ability subjects was not significant for important items, $F(1,152) = 2.2$. Differences in verbal ability were highly significant for unimportant items, $F(1,152) = 27.8$, $p < .01$. The significant Importance X Salience X Verbal ability interaction could be attributed to the markedly

Table 3A

Cell Means for the Interaction of List and Importance on the Proportion Correct for the Target Question, Experiment I

	List	
	A	B
Important	.92	.80
Unimportant	.75	.91

Table 3B

Cell Means for the Interaction of List and Importance on the Proportion Correct for the Target Question, Reordered by Passages, Experiment I*

	Passages	
	1,2,5	3,4,6
Important	.92(A)	.80(B)
Unimportant	.91(B)	.75(A)

*List membership shown in parentheses

depressed scores of low verbal ability people on difficult unimportant paragraphs.

The Importance X List interaction was significant. Again, this was due to differences in the difficulty of the passages. The effect of importance was consistent across the two passage groups.

Filler. None of the main effects of the experimental factors approached significance, $F(1,152) < 1$, in all cases.

Conditional probabilities. In each passage set, the premise contained information which was needed to make the target inference, and the importance manipulation served to establish the importance of the inference. It was therefore decided to examine the probability of correctly answering the target items conditional upon a correct answer of (1) the premise question, (2) the importance manipulation question, and (3) both the premise and the importance manipulation questions. Analyses of variance were conducted on the conditional probabilities. A summary of all significant effects for the three measures is shown in Table 4.

Passages 1 and 2 had two premise questions. For these passages, the premise was counted correct only if both questions were correctly answered. For the probability of correctly answering a target question, given that the premise question was correctly answered, the main effect of importance (Important = .87, Unimportant = .84) did not reach significance. However, further analyses of the significant Importance X Explicitness interaction revealed that manipulating importance made a significant difference for implied versions (Important = .84, Unimportant = .75), $F(1,149) = 9.9$, $p < .01$, but not for stated versions (Important = .91, Unimportant = .94), $F(1,149) < 1$. Similarly, the Salience X Explicitness interaction resulted

Table 4

Summary of Significant F-values

for Three Conditional Probabilities, Experiment I

Effects	Conditional Probabilities		
	P(Target | Premise)[a]	P(Target | Importance Manipulation)[b]	P(Target | Premise and Importance Manipulation)[c]
Explicitness of the Target (E)	25.9**	33.4**	21.2**
Grade (G)	4.4*		
Verbal Ability (VA)	4.5*	5.6*	
Importance of the Target (I) x E	6.8**		7*
I x List (L)	88.3**	39.4**	75.5**
Salience of the Premise (S) x E	5.4*	11.2**	5.8*
G x VA	6.2*		6.3**
I x E x L	29.1**	7.5**	17.8**
S x E x VA		5.0*	
S x G x L	3.8*	4.1*	
E x G x L	4.9*		3.8*
I x E x G x L	8.0**		
S x E x G x VA		7.6**	5.1*

*$p < .05$

**$p < .01$

[a] Probability of answering the target question correctly given that the premise question was answered correctly. Degrees of freedom for these F-values were 1,149.

Table 4 (Continued)

[b]Probability of answering the target question correctly given that the importance manipulation question was answered correctly. Degrees of freedom for these F-values were 1,144.

[c]Probability of answering the target question correctly given that the premise and importance manipulation questions were answered correctly. Degrees of freedom for these F-values were 1,131.

from the significant simple main effect of salience for the implied versions (Low = .74, High = .84), $F(1,149) = 8.3$, $p < .01$, and the absence of a salience effect for stated versions (Low = .94, High = .91), $F(1,149) < 1$. Overall, the main effect of salience failed significance. The conditional probability was much higher for stated than implied targets (.93 vs. .79). The Importance X List and Importance X Explicitness X List interactions were caused by a difference in the difficulty of the passages. The main effects of verbal ability and grade level, as well as their significant second-order interaction were caused by the poor performance of the ninth and tenth graders with low verbal ability scores.

In the analysis of the probability of correctly answering the target question given that the importance manipulation was correctly answered, the only experimental variable which produced a main effect was explicitness, as explicit versions resulted in higher conditional probabilities (.93 vs. .77). The Importance X Explicitness interaction only approached signigicance, $F(1,144) = 3.2$, $p = .08$; however, the simple main effect of importance was again significant for passages in which the target was implied (Important = .81, Unimportant = .74), $F(1,144) = 4.4$, $p < .05$. Differences in the difficulty of the passages produced significant Importance X List and Importance X Explicitness X List interactions. The Salience X Explicitness interaction was significant and the salience main effect approached significance, $F(1,144) = 3.0$, $p = .09$, as highly salient premises produced higher conditional probabilities in the implied condition (High = .84, Low = .70).

For the analysis of the probability that the target question was correctly answered, given that both the premise and importance manipula-

tion questions were correctly answered, the critical Importance X Explicitness interaction again reached significance, as the important passage versions produced higher conditional probabilities than did the unimportant versions for the implied condition (.84 vs. .77), but importance produced no effect when the target was stated. The Salience X Explicitness interaction reached significance as highly salient premises increased the conditional probability for implied targets (.85 vs. .76), but not for stated targets. Passages in which the target was stated produced much higher scores than implied passages (.93 vs. .80) while the main effects of both importance and salience failed significance. Once again differences in the difficulty of the passages were reflected in significant Importance X List and Importance X Explicitness X List interactions. The main effects of grade level and verbal ability failed significance, but their second-order interaction was significant, due to the poor performance of low verbal ability ninth and tenth grade students.

Ratings. The subjects' ratings were subjected to analyses of variance. These ratings indicated the perceived closeness of the selected alternative to the passage on the following scale:

1 = Exact quote from the story

2 = Paraphrase of the story

3 = Directly implied by the story

4 = Consistent with the story.

It should be noted that lower ratings indicate greater perceived closeness. Only the ratings of correctly answered items were entered in the analyses. In order to be included in an analysis, a subject was required to have at least one correct response for each importance condition. Significant effects from analyses of variance on ratings of the target, premise, and

importance manipulation questions are summarized in Table 5.

Target. Table 6 shows the mean rating for each combination of importance, salience, and explicitness. When the target had been stated, it was rated as much closer to the presented text than when it had been implied (1.90 vs. 2.56), $F(1,145) = 50.6$, $p < .01$. The fact that the ratings were sensitive to this manipulation provides evidence for the validity of this measure.

The most interesting comparison produced a significant result: the targets from important versions were rated as closer to the passage than those from unimportant versions (2.16 vs. 2.30). The Importance X Explicitness interaction approached significance, $F(1,145) = 3.0$, $p = .09$. The difference between important and unimportant targets was greater for the implied (Important = 2.44, Unimportant = 2.69) than stated condition (Important = 1.88, Unimportant = 1.92). Simple main effects tests confirmed that the importance effect was significant only for the implied condition, $F(1,145) = 10.4$, $p < .01$.

Ninth and tenth graders tended to use lower ratings than did eleventh and twelfth graders (2.09 vs. 2.37). The Explicitness X Grade Level interaction was tested for simple main effects. The simple effect of grade level was significant in the implied condition (Low = 2.30, High = 2.82), $F(1,145) = 17.1$, $p < .01$., but not in the stated condition (Low = 1.87, High = 1.92), $F(1,145) < 1$.

In order to permit a direct test of the prediction that important targets would more often be rated as having been stated in the passage than unimportant targets, the rating data were collapsed in order to compute

Table 5

Summary of Significant F-values for the Rated Closeness to the Original Passage for Three Question Types, Experiment I

Effects	Question Type		
	Target[a]	Premise[b]	Importance Manipulation[c]
Importance of the Target (I)	5.9*		21.2**
Explicitness of the Target (E)	50.6**	5.9*	
Grade (G)	9.2*	4.0*	
List (L)			4.1*
I x L			6.5*
E x G	6.3*		
G x L	5.0*		
I x Salience of the Premise (S) x E x Verbal Ability (VA)		4.8*	
S x E x G x VA	5.4*		
S x E x VA x L	6.8*		
I x S x E x G x VA x L		4.0*	

*$p < .05$

**$p < .01$

[a]Degrees of freedom for these F-values were 1,145.

[b]Degrees of freedom for these F-values were 1,149.

[c]Degrees of freedom for these F-values were 1,144.

Table 6

Mean Rated Closeness to the Passage* for

Correctly Answered Target Questions, Experiment I

Explicitness of the target	Salience of the premise	Importance of the target		
		Important	Unimportant	Total
Stated	High	1.92	2.02	1.97
	Low	1.83	1.82	1.83
	Total	1.88	1.92	1.90
Implied	High	2.46	2.61	2.54
	Low	2.42	2.76	2.59
	Total	2.44	2.69	2.56
Total	High	2.19	2.32	2.25
	Low	2.13	2.28	2.21
	Total	2.16	2.30	

*Rating scale used was as follows:

1 = Exact quote of the story

2 = Paraphrase of the story

3 = Directly implied by the story

4 = Consistent with the story

the proportion of items which were judged to have been stated in the passage, that is, the number of correctly answered target questions which received a rating of 1 or 2. The means organized by the three experimental variables are shown in Table 7. Important targets were indeed more often rated as having been stated in the passage than unimportant targets (.66 vs. .58), $F(1,145) = 6.7$, $p < .05$. This effect was especially pronounced for implied targets (Important = .50, Unimportant = .39). This analysis further emphasized the subjects' ability to distinguish between stated (.79) and implied (.45) versions, $F(1,145) = 63.3$, $p < .01$. None of the interactions involving importance approached significance.

Premise. Neither the salience of the premise nor the importance of the inference affected premise ratings. The premise was rated as closer to the original passage for implied than for stated versions (1.73 vs. 1.91). Eleventh and twelfth graders rated the premise as closer to the original than did ninth and tenth graders (1.75 vs. 1.90).

Importance manipulation. The analysis of variance on ratings of importance manipulation questions yielded three significant effects. The important versions were rated much closer than were unimportant versions (1.77 vs. 2.02). This difference was far more pronounced for the group of Passages 3, 4, and 6 (Important = 1.75, Unimportant = 2.17) than for Passages 1, 2, and 5 (Important = 1.79, Unimportant = 1.86) as shown by the significant Importance X List interaction reordered by passages. Finally, the main effect of list was significant (A = 1.98, B = 1.80).

Summary of the results: Experiment 1. When people read text, they are more likely to make an inference based on that text if the inference is important to the story they are reading. This is evidenced by the fact

Table 7

Proportion of Correctly Answered Target Questions

Rated as Having been Stated in the Text, Experiment I

Explicitness of the target	Salience of the premise	Importance of the target		
		Important	Unimportant	Total
Stated	High	.78	.71	.74
	Low	.84	.83	.83
	Total	.81	.77	.78
Implied	High	.48	.43	.45
	Low	.53	.36	.44
	Total	.50	.39	.45
Total	High	.63	.57	.60
	Low	.68	.59	.64
	Total	.66	.58	

that for implied passage versions, in which the answer to the target question had to be inferred, correct recognition of the target was greater after reading important passage versions than after unimportant versions. No effect of importance was found for targets which had been stated. Salience of the premise also had an effect on the probability of correctly inferring an implied target. For passages in which the target had been stated, salience had no effect. Not surprisingly, subjects in the stated condition, who read passages which contained statements of the target, did far better than subjects in the implied condition.

Premises contained information which invited the target inference. No effect of the explicitness or importance of the target on the recognition of premise information was found. When performance on the target was conditionalized on correct recognition of premise information, important inferences were still more likely to be correctly recognized.

The importance manipulation questions tested the information which extablished the importance of the target inference in the passage. The proportion of importance manipulation questions correctly answered was much higher for important passage versions than for unimportant versions. The form and meaning of the importance manipulation material was confounded with importance value, however, so the interpretation of this finding is unclear. The probability of the target being correct, given that the importance manipulation question was correctly answered, was greater for important implied passages than for unimportant implied passages.

When target question performance was conditionalized on correct answers to both premise and importance manipulation questions, the simple main effect of importance for the implied condition again confirmed the

advantage of important inferences. In this analysis the main effects of grade level and verbal ability, which were highly significant for the simple proportion correct of target items (and the proportion correct of all other question types as well), failed significance. Thus, once scores for passages on which the subject failed to encode and retain the information related to the target had been discounted, no effect of grade level or verbal ability remained.

Unrelated or filler questions were also included and analyzed. The possibility of the importance effect being due to some sort of diffuse, nonspecific facilitation was disconfirmed by the absence of any effect of importance on these filler items.

The present study also involved a rating of how close an answer was to the original passage. As predicted, important inferences were rated as closer to the original passage than unimportant inferences. An additional analysis revealed that importance increased the proportion of inferred targets rated as having been explicitly stated in the passage. The ratings of target questions proved highly sensitive to the explicitness of the target: subjects who read passages in which the target was stated were far more likely to rate it as explicitly stated than were subjects who read passages in which the target was implied.

Premise questions were rated as closer to the original passage for implied than for stated passages. This suggests that subjects processed premises more deeply or extensively when they were needed to derive an inference. These ratings might be seen as a more sensitive measure of comprehension and memory, since no effect of the explicitness of the target was found for the proportion of premise questions correctly answered.

However, premises in passages in which the target was important were not rated as closer to the passage, although deeper processing of the premise was predicted for this condition.

The importance manipulation questions were rated as closer to the original important passages than to the unimportant passages, but since the form and content of this material was confounded with importance value, this result is ambiguous.

The major predictions of the study were thus confirmed: important inferences were more often correctly recognized and also were more likely to be rated as having been explicitly stated in the passage than were unimportant inferences. Highly explicit premises also increased the likelihood that implied targets would be correctly recognized.

CHAPTER III

EXPERIMENT II

Method

Design. The design was the same as that for Experiment I.

Subjects. The subjects were 198 students from a high school in east central Illinois and a high school in Northwestern Ohio. They were run in groups of 15 to 30 students.

Materials. The passages were the same as those used in Experiment I. Four completion questions were prepared for each passage. The questions for Passage 1 are shown in Figure 3. Each question set contained a target question, an importance manipulation question, and one or two premise questions. A filler question was included for those question sets with one premise question in order to equate the number of questions per passage. Questions were presented in booklets as in Experiment I.

Procedure. Instructions and procedures for the study phase and vocabulary test were the same as for Experiment I. Test instructions stressed that the subjects should work through the booklet in order and that they should answer as many questions as possible. They were told to answer the questions according to the story, with answers that might be just a few words and should never be "longer than a sentence or two." Subjects were told to work at their own pace.

Results

Answers were scored for gist. If an answer was essentially a paraphrase of the story element, or a verbatim representation, it was scored as correct. If some material was added to, deleted from, or distorted in the answer, so as to change its meaning, but the answer was still identifiable

Figure 3

Cued Recall Questions for Passage Set 1,

A Career in Sales

Experiment II

Target Question

1.* Why was Joan late getting to the airport?

Premise Questions

2. What did Joan remember as she was finishing packing for her trip?

3. At the beginning of the story, how much time did Joan have to finish and to get to the airport?

Importance Manipulation Question

4. What happened to Joan's original two o'clock flight to San Francisco?

*Numbers indicate the order in which the questions appeared in the test booklet.

as related to the story element, it was scored as partially correct. The scoring was done by a highly skilled assistant who was not aware of the nature of the experiment. The experimenter independently scored twenty protocols. The interrater reliability was .90.

Proportion correct and partially correct. Analyses were conducted on the proportion correct, and proportion correct or partially correct for target, premise, and importance manipulation questions. Filler questions were not analyzed because not all passages had filler questions. Except where noted, all analyses of variance reported below were six-way mixed analyses with importance as the within-subjects factor and salience, explicitness, list, grade level, and verbal ability as between-subjects factors.

Significant effects for the analyses of proportion correct and partially correct for the target, premise, and importance manipulation questions are shown in Table 8. In each analysis, subjects with high verbal ability and students in the higher grade level performed better, as evidenced by significant verbal ability and grade level effects.

Target. The mean proportion correct and partially correct for the target questions is reported by importance, salience, and explicitness in Table 9. For the proportion correct, important versions produced higher scores than unimportant versions (.70 vs. .63). Simple main effects tests on the significant Importance X Explicitness interaction revealed that important passages exceeded unimportant passages in the implied condition (.60 vs. .47), $F(1,166) = 14.2$, $p < .01$. Thus, the effect of importance on the probability of an inference was replicated with cued recall. The effect of importance (Important = .79, Unimportant = .78) failed significance for the stated versions, $F(1,166) < 1$. When the salience of the premise was

Table 8

Summary of Significant F-values for the Proportions Correct and Partially Correct for Three Types of Questions, Experiment II

Effects[a]	Question Type					
	Target		Premise		Importance Manipulation	
	Correct	Partially Correct	Correct	Partially Correct	Correct	Partially Correct
Importance of the Target (I)	7.6**	10.2**			15.7**	64.6**
Salience of the Premise (S)		6.3*	4.7*	5.4*	4.9*	
Explicitness of the Target (E)	62.1**	68.7**				
Grade (G)	15.4**	9.7**	12.7**	12.1**	21.1**	18.3**
Verbal Ability (VA)	6.1*	5.3*	7.8**	7.6**	16.8**	15.1**
List (L)					25.2**	23.7**
I x S	5.4*					
I x E	5.6*	6.0*				6.5*
I x L	11.6**	5.7*	54.0**	53.4**	6.0*	23.8**
S x E	4.1*	5.0*				

(continued on next page)

Table 8 (continued)

Effects[a]	Target		Premise		Importance Manipulation	
	Correct	Partially Correct	Correct	Partially Correct	Correct	Partially Correct
I x S x E	6.0*	8.5**				
I x S x G					5.0*	
S x G x L						3.9*
S x VA x L			4.0*			
I x S x E x VA					6.0*	
I x S x G x VA					6.1*	
I x S x VA x L			4.7*			
I x E x VA x L			4.2*			
I x G x VA x L		3.9*			6.1*	4.3*
S x E x G x L					5.8*	

*$p < .05$

**$p < .01$

[a]Degrees of freedom for all F-values were 1,166.

Table 9

Mean Proportion Correct and Partially Correct for the Target Question, Experiment II*

Explicitness of the target	Salience of the premise	Importance of the target		
		Important	Unimportant	Total
Stated	High	.79 (.86)	.78 (.87)	.79 (.87)
	Low	.80 (.88)	.78 (.83)	.79 (.86)
	Total	.79 (.87)	.78 (.85)	.79 (.86)
Implied	High	.72 (.79)	.47 (.58)	.60 (.68)
	Low	.48 (.55)	.47 (.52)	.47 (.54)
	Total	.60 (.67)	.47 (.55)	.54 (.61)
Total	High	.76 (.82)	.63 (.73)	.69 (.77)
	Low	.64 (.72)	.63 (.68)	.63 (.70)
	Total	.70 (.77)	.63 (.70)	

*Proportions for the partially correct measure shown in parentheses.

low, performance on the target question was lower than when the premise was highly salient (.63 vs. .69), though the effect was only marginally significant, $F(1,166) = 3.6$, $p = .06$. As revealed by the Salience X Explicitness interaction, the effect of salience obtained only in the implied condition (Low = .54, High = .68); the two levels of salience produced almost identical scores in the stated condition (Low = High = .86). The subjects who read passages in which the target was stated did much better than those for whom the target was implied (.79 vs. .54).

The Importance X List interaction, when reordered by passage set, revealed that the effect of importance was much more pronounced for the group of Passages 1, 2, and 5 (Important = .76, Unimportant = .65), than for Passages 3, 4, and 6 (Important = .63, Unimportant = .61). For passages in which the target was implied, the superiority of the important high salience passages over other passage versions produced a significant Importance X Salience X Explicitness interaction. None of the interactions involving the subject status variables reached significance.

The analysis that included partially correct answers to target questions was similar to the above analysis in all important respects. The effect of importance was again highly significant, and much more pronounced for the implied versions (Important = .68, Unimportant = .55), where the target had to be inferred, than for the passages in which the target had been stated (Important = .87, Unimportant = .85), producing a significant Importance X Explicitness interaction. Examination of the Salience X Explicitness interaction revealed that the main effect of explicitness was completely accounted for in the implied condition. A significant Importance X Salience X Explicitness interaction resulted from the high scores obtained by subjects for important highly salient versions of the implied passages rela-

tive to the other implied versions. Inspection of the Importance X List interaction showed that the advantage of important versions was most marked for the set of Passages 1, 2, and 5.

For about 6% of the question sets, a subject produced an answer which constituted a correct response to the target question when answering a premise or importance manipulation question. An additional analysis was conducted in which the target was counted correct if the answer to the target question itself was correct or partially correct, or if an acceptable answer to the target question appeared as the answer to one of the other questions. The results of this analysis were essentially identical to the analysis of the partially correct measure.

Premise. Highly salient premises were better recalled than less salient premises for both the correct (.56 vs. .50) and partially correct (.57 vs. .50) measures. The importance and the explicitness of the target both failed to affect recall of the premise. The highly significant Importance X List interaction resulted from differences in difficulty between the passage sets (for example, for the proportion correct, Passages 1, 2, 5 = .60, Passages 3, 4, 6 = .46).

Importance manipulation. In the analyses of the questions which tested the material embodying the importance manipulation, performance on the important versions exceeded the unimportant versions (.75 vs. .66 for correct, .89 vs. .72 for partially correct). The Importance X List interaction, when reorganized by passages, revealed that the advantage of important passages held only for the group of Passages 3, 4, and 6 (.79 vs. .56 for correct, .90 vs. .61 for partially correct). For Passages 1, 2, and 5, the effect of importance was inconsistent across the two performance measures

(.70 vs. .76 for correct, .87 vs. .84 for partially correct). List B was much better recalled than List A. Although several other effects reached significance, only one fourth-order interaction obtained for both dependent measures.

Conditional probabilities. The probability of correctly answering the target question given that the premise, the importance manipulation, or both had been correctly answered using both strict and lenient scoring criteria, was subjected to the six-way analysis of variance. However, the number of cases meeting the conditions was very low in some analyses. Since neither grade nor ability had effects, these variables were dropped and the data were reanalyzed in four-way mixed analyses with salience, explicitness, and list as between-subjects factors and importance as the within-subject factor. Significant effects from all three analyses are summarized in Table 10.

For Passages 1, 2, and 4, which each had two premise questions, the premise was counted correct only if both questions were correct. When the probability of correctly answering the target given that the premise question was correctly answered was analyzed, important passage versions produced higher conditional probabilities than the unimportant versions (.84 vs. .74 for correct, .87 vs. .78 for partially correct). Conditional probabilities were much higher for subjects who read passages in which the target was stated than for those who read the implied versions (.88 vs. .70 for correct, .89 vs. .76 for partially correct). In this analysis, which was conditional upon a correct answer to the premise question, salience of the premise had no effect. The Importance X Explicitness and Importance X Salience X Explicitness interactions, which were significant in the analyses of the simple proportion of target questions correctly answered,

Table 10

Summary of Significant F-values for Six Conditional Probabilities, Experiment II

Effects	Conditional Probabilities					
	P(Target|Premise)[a]		P(Target|Importance Manipulation)[b]		P(Target|Premise and Importance Manipulation)	
	Correct	Partially Correct	Correct	Partially Correct	Correct	Partially Correct
Importance of the Target (I)	5.5*	4.8*	14.7**	22.7**	8.7**	8.4**
Salience of the Premise (S)				3.9*		
Explicitness of the Target (E)	16.0**	11.3**	46.5**	91.0**	14.2**	15.8**
List (L)			4.2*			
I x S			7.2**			
I x E			5.8*	5.6*		
I x L			6.3*			
I x S x E				4.0*		
I x E x L			6.5*			

(continued on next page)

Table 10 (continued)

*$p < .05$

**$p < .01$

[a]Probability of answering the target question correctly given that the premise question was answered correctly. Degrees of freedom for these F-values were 1,127 for correct and 1,129 for partially correct.

[b]Probability of answering the target question correctly given that the importance manipulation question was answered correctly. Degrees of freedom for these F-values were 1,174 for correct and 1,177 for partially correct.

[c]Probability of answering the target question correctly given that the premise and importance manipulation questions were answered correctly. Degrees of freedom for these F-values were 1,101 for correct and 1,109 for partially correct.

here failed to approach significance. No other effects approached significance.

As Table 10 shows, the analyses of the probability of correctly answering the target question given that the importance manipulation question was answered correctly produced a number of effects which attained significance for only one of the two analyses. Only those effects which were significant across both correct and partially correct measures will be discussed here. The conditional probabilities were higher for important than for unimportant passages (.74 vs. .63 for correct, .82 vs. .70 for partially correct). Stated passages produced much higher conditional probabilities than did implied passages (.81 vs. .56 for correct, .90 vs. .62 for partially correct). The Importance X Explicitness interaction reached significance because the effect of importance was much greater when the target had to be inferred (e.g., for correct, Important = .66, Unimportant = .47 for implied passages, Important = .83, Unimportant = .79 for stated passages).

Table 11 shows the mean probability of correctly answering the target question, given that both premise and importance manipulation questions were correctly answered. The important versions produced higher conditional probabilities than the unimportant versions for both the correct and partially correct measures (.84 vs. .69 and .88 vs. .74, respectively). Stated targets were better than implied targets (.84 vs. .67 for correct, .88 vs. .74 for partially correct). As was found in the analysis which conditionalized on correct responses to the premise questions only, salience of the premise had no effect and the Importance X Explicitness and Importance X Salience X Explicitness interactions did not approach significance.

Table 11

Probability of Answering the Target Question Correctly Given that the Premise and Importance Manipulation Questions were Answered Correctly, Experiment II*

Explicitness of the target	Salience of the premise	Importance of the target		
		Important	Unimportant	Total
Stated	High	.92 (.94)	.80 (.86)	.86 (.90)
	Low	.91 (.94)	.83 (.85)	.87 (.90)
	Total	.91 (.94)	.81 (.86)	.86 (.90)
Implied	High	.84 (.85)	.54 (.56)	.69 (.71)
	Low	.69 (.78)	.59 (.69)	.64 (.73)
	Total	.77 (.81)	.57 (.63)	.67 (.72)
Total	High	.88 (.89)	.67 (.71)	.77 (.80)
	Low	.80 (.86)	.71 (.77)	.76 (.81)
	Total	.84 (.88)	.69 (.74)	

*Conditional probabilities for the partially correct measure shown in parentheses.

Summary of the results: Experiment II. When cued recall was employed as a test of inference, the probability that an inference would occur was again found to be greater for important than for unimportant inferences. The significant main effect of importance in the study derived solely from the passage versions where the target was implied, and primarily from the highly salient implied versions. Similarly, salience of the premise affected the likelihood that the target inference would be drawn but had no effect when the target had been stated in the passage.

The accuracy of cued recall for premises was influenced by neither the importance nor the explicitness of the target. Highly salient premises were better recalled than less salient premises. The probability of correctly supplying the target, conditional upon correctly supplying the premise, again favored important targets. Salience of the premise had no effect on the recall of the target in this conditional analysis.

The information which was changed in order to manipulate importance proved to be much easier to recall for the important versions than for the unimportant versions. The effect of importance on the target questions was highly significant when conditionalized upon a correct response to the importance manipulation question. In other words, subjects were particularly likely to produce an important inference if they realized its importance, as evidenced by the ability to recall the information that established its importance.

For the probability of correctly answering the target given that the premise question, or the premise and importance manipulation questions, had been correctly answered, the effect of importance was consistent across stated and implied versions.

CHAPTER IV

GENERAL DISCUSSION

People are more likely to make an inference if it is important than if it is unimportant. That this is so has been documented in two experiments, and has been found using both multiple-choice recognition and cued recall measures. While the significance of the effect did not generalize across all materials, in each experiment the trend that important inferences were made more often than unimportant inferences was observed for four of the six passage sets. Given the intuitive nature of the importance manipulation in these studies, the effect has shown reasonable generality. If importance were more rigorously defined, or if extensive piloting were employed to insure that the intuitions of the target population agreed with those of the experimenter, no doubt the success rate of .67 could be improved upon. For the recognition test, the effect of importance was consistent across two levels of the salience of premise information. For the cued recall test, important inferences exceeded unimportant inferences only when the premises were highly salient. Probably when the premises were less salient there were not sufficient cues to insure that importance would increase the probability of the target inference being made; instead importance only increased the probability that some inference would be made. When subjects correctly recalled the premise and importance manipulation, the effect of importance was consistent across highly salient and less salient passage versions.

The studies reported here are among the first to explore the effect of text content and structure on inference. Nearly all of the previous research has been designed to (a) demonstrate that inference is an important

and pervasive process, (b) establish whether the temporal locus of inference is at comprehension or at test, or (c) explore the effect of instructions and tasks on inference.

The present research may be viewed as an extension of the literature on the effect of importance on memory for text. Johnson (1970), Meyer (1975), Meyer and McConkie (1973), Kintsch and Keenan (1973), and others have shown that importance improves memory for explicitly stated material. The current research establishes that importance also increases the probability that an inference will be made. In these studies, the effect of importance did not reach significance for targets which had been stated. However, in the recognition test of Experiment I, this may have been due to a ceiling effect. In Experiment II, when consideration was restricted to those passages for which a subject encoded and retained enough of the material related to the inference to permit him or her to correctly recall the premise and importance manipulation items, the effect of importance was consistant across stated and implied versions.

While the studies were not designed to test whether the temporal locus of the importance effect was at comprehension or at test, some evidence related to this issue was obtained. In Experiment I, subjects were more likely to rate an inference as having been stated in the passage if the inference was important than if it was unimportant. This result is exactly what would be expected if importance served to increase the probability that an inference would be made during comprehension, and if subjects were sometimes unable to distinguish between inferences made during reading and statements which had actually been read. However, this could also result from a higher proportion of lucky hits for unimportant inferences. Unimportant inferences

were less often correctly recognized, and it is therefore reasonable to assume that a higher percentage of the correct responses were lucky guesses. If subjects had simply guessed at the answer to the inference question, they would presumably be aware of that fact and might therefore be less likely to rate the answer as having been stated in the passage. Thus, the ratings do not unequivocally support the hypothesis that the locus of the importance effect was at comprehension.

Perhaps more convincing evidence that many inferences, and therefore much of the effect of importance on inference, occurred at comprehension is that the probability of correctly answering the inference question, given that the premise question had been incorrectly answered, was well above chance in both studies (.67 for Experiment I, .43 and .52 for correct and partially correct measures, respectively, in Experiment II). To the extent that the premise questions querried information which was required in order to make an inference, subjects who missed the premise question could only answer the inference question correctly if they had made the inference during reading or if they guessed. However, as I argued in the portion of the introduction which dealt with the temporal locus of inference, it is unlikely that inferences are made only at comprehension or at test, and the evidence here does not conclusively disconfirm the possibility that importance might also affect the probability of inference at test.

One explanation of the importance effect which has some a priori appeal is clearly disconfirmed by the data. Importance might serve to increase the probability or quality of encoding the information needed to make the inference. If this occurred, the probability of being able to make at test an inference which had not been made at encoding would be

greater for important than unimportant inferences, since the probability of retaining at test the information necessary to make the inference would be greater for important inferences. The essential prediction of this hypothesis to the present studies is better performance on premise questions for important passage versions. Neither the recognition nor cued recall of premises showed any hint of an effect for importance. In the passages used in these studies, the information which established the importance of an inference came at the end of the passage, after all of the other material related to the inference. The passages are similar in this respect to those of Thorndyke (1976), and to a lesser extent to the materials employed by Spiro (1975). If the importance manipulation had appeared at the beginning of the passage, it would presumably affect the initial encoding of related information and lead to better memory for the premises of important information.

If the effect of importance had occurred at comprehension in the present studies, it must have been a backward effect. One possible scenario would be that when a subject discovered that an event, like being late to the airport, was important in the story, the subject would check his or her memory for the event to see if it was a fully elaborated, coherent account. If the memorial representation of the event was not coherent, as would be the case if the subject had not inferred the cause of lateness, the subject would look back through the passage in order to find information which would permit the event to be elaborated so as to make it coherent. This scenario is a special case of the hypothesis discussed above that importance would serve to increase the probability of encoding the premise information. That this did not often occur is evidenced by the lack of an importance effect

on the premise questions. The reason that it did not occur may have been that fitting an experiment in which students read and were tested on six passages into a 40-minute school period dictated that reading times be kept to a minimum. Observation of the subjects during the experiments suggested that many had barely enough time to read the passages completely, and that many others seemed to adopt the strategy of reading straight through the passage once at a rapid rate, and then waiting for the signal to go on. If subjects had insufficient time to finish some of the passages, the effect of importance would be attenuated since the importance manipulation came at the end of the passage. If subjects had just enough time to finish the passage or if they adopted a "don't look back" reading strategy, then this could account for the lack of an importance effect on premise questions.

One variation on the above scenario is that when a coherence check for an important event fails, the subject would initiate a search of memory for the passage in order to see if any information related to the event could be retrieved to permit the inferential elaboration of a coherent account. If the information is found, the invited inference would be made. If the information is not found, an inference would be constructed on the basis of prior knowledge, sometimes producing an "incorrect" inference. This account is consistent with the finding in Experiment II that important inferences were more likeiy to be recalled for passages with salient and therefore memorable premises, but not for passages with low salience. For those passages for which a subject remembered the premise, the probability of recalling the target inference was higher in the important condition. This explanation, however, also would seem to predict better recall for premises in important passage versions.

A final possibility that deserves consideration is that the importance may simply motivate subjects to try harder to answer questions correctly. By this motivational explanation, it is not essential that importance differentially affect either the probability of the inference at comprehension or the encoding of the premise. A motivational explanation explains better retrieval of inferences made at comprehension and higher probability of correctly making the inference at test, given that the premise information is available. In fact, the motivation hypothesis also explains better memory for explicitly stated material, which is typical of important information, as shown by Johnson (1970), Meyer (1975), and others. Studies in which incentives for remembering information would be manipulated could be used to test this hypothesis.

In conclusion, this research has demonstrated rather convincingly that people are more likely to make an inference in text if it is important. While the studies provide some evidence against several explanations of the effect, much remains to be resolved before our understanding of the effect of importance on inference is complete.

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